Aflatoxin Reduction by Screening Farmers Stock Peanuts

F.E. Dowell *, J. W. Dorner, R. J. Cole and J. I. Davidson, Jr.[1]

ABSTRACT

Samples from 17 loads of farmers stock peanuts suspected of containing aflatoxin were screened over a belt cleaner, shelled, and sorted into grade components. Tests showed that removal of loose shelled kernels (LSK) and small pods by belt screening reduced aflatoxin levels by an average of 35%. Belt screening removed 97% by weight of the LSK, but only 4% of the sound mature kernels and sound splits (SMK+SS). Further removal of other edibles (OE), oil stock (OS), LSK, and damaged kernels (DK) from the peanuts riding over (OVERS) the belt screen reduced aflatoxin levels from an average of 110.7 ppb in the unscreened load to 3.8 ppb in SMK+SS. The OE, OS, LSK and DK were removed from the OVERS through the use of slotted screens and by sorting.

Key Words: Aflatoxin, belt screening, grade components, aflatoxin reduction

Aflatoxins, mycotoxins produced by *Aspergillus flavus* and *A. parasiticus*, may occur in peanuts. Therefore, if aflatoxins are present and levels are excessive, steps must be taken to reduce the concentration of aflatoxin in edible peanuts to an acceptable level (i.e. <20 parts per billion (ppb) established level for crop year (CY) 1988 peanuts). Previous studies on farmers stock peanuts indicated that when aflatoxins occur, loose shelled kernels (LSK), damaged kernels (DK), and small kernels are more likely to be contaminated with aflatoxin than sound mature kernels (SMK) and sound splits (SS) (1,2,7). Since aflatoxins are concentrated in specific components of peanuts, emphasis can be placed on removing those components to reduce the aflatoxin concentration in edible peanuts.

In the past, LSK and small pods could be cleaned from a farmers stock (FS) load to improve quality (3), but not at a rate fast enough to allow all FS peanuts going into storage to be cleaned. The development of a belt screening device (6) has made it possible to rapidly remove LSK and small pods from a farmers stock load of peanuts. Therefore, the effect of screening and the separation of shelled peanuts into grade components on removing aflatoxin contaminated kernels from FS peanuts was studied.

The specific objectives of this study were to: 1) determine the aflatoxin concentrations in grade components of screened and unscreened peanuts, 2) determine the percent of the total meats removed by belt screening, and 3) determine the percent of the total meats removed when aflatoxin suspect components are screened and sorted out.

Materials and Methods

Ten ca. 15 kg samples of CY 1987 Florunner peanuts (*Arachis hypogaea L.*) were collected from each of seventeen loads of FS peanuts. Ten pneumatic probe patterns were used to collect the 10 samples, each probe pattern producing one sample. The loads were selected from drought stressed fields and suspected of containing aflatoxin. Each sample was screened over a belt screen with belts spaced 9.5 mm (24/64 in) apart. The peanuts that rode over (OVERS) and fell through (THRUS) the screen were separately cleaned, shelled, and sized. The SMK+SS, other edibles (OE), oil stock (OS), and DK from each sample were weighed. OE are kernels falling through a 16/64 inch by 3/4 inch slotted screen, but riding a 14/64 inch by 3/4 inch slotted screen. OS are those kernels falling through the 14/64 inch by 3/4 inch slotted screen. Because there were few LSK (<3% of total LSK) in the OVERS, the LSK from the OVERS and THRUS were combined. Figure 1 shows the flow diagram of these procedures. All peanuts in each component, except the SMK+SS, were comminuted and analyzed for aflatoxin using high pressure liquid chromatography (HPLC) (5). The SMK+SS sample was comminuted in a subsampling mill that provided two subsamples, each being 5% of the total SMK+SS (4). The subsamples were analyzed separately using HPLC.

The total aflatoxin concentration for the OVERS and THRUS was determined by calculating a weighted average of the aflatoxin concentrations of the respective components. The aflatoxin concentration in the unscreened samples was determined by calculating a weighted average of the total OVERS and THRUS aflatoxin concentrations.

[1]Agricultural Engineer, Microbiologist, Research Microbiologist, and Mechanical Engineer, USDA, ARS, National Peanut Research Laboratory, 1011 Forrester Drive, S. E., Dawson, Georgia 31742.

*Corresponding author.

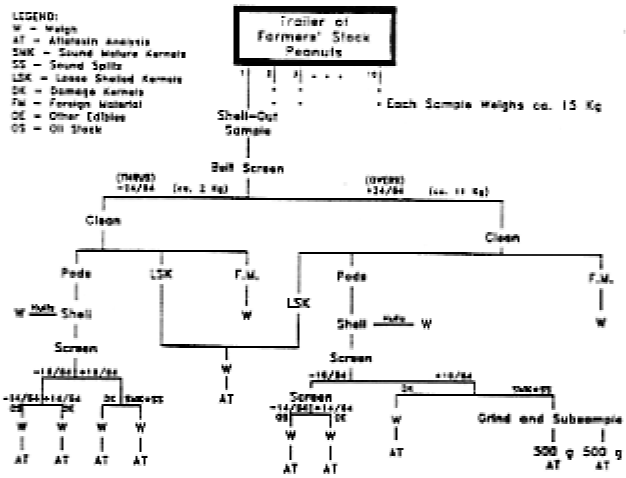

Fig. 1. Schematic of test procedure to determine aflatoxin levels in components of farmers stock peanuts.

Results and Discussion

Table 1 shows the mean aflatoxin concentration, average of the 10 samples from each trailer, for each individual component and for the total load before screening. When data from 17 trailers were averaged, it was seen that the SMK+SS, which comprised 76% of the total meats (Table 2), contained only 3.2 ppb of aflatoxin compared to 110.7 ppb for the unscreened load average. The highest concentration of aflatoxin was found in the damaged peanuts, which comprised only 1.5% of the total meats. The LSK (8.5% of the meats) had the second highest concentration of aflatoxin. On the average, the OE and OS components contained about the same amount of toxin (about 65 ppb) and together accounted for about 14% of the meats. The aflatoxin-suspect component most efficiently removed by belt screening was the LSK, with an average of 97% removed (Table 3). However, since only 4% of the DK, 18% of the OE, and 31% of the OS were removed by belt screening, further screening and sorting of these components after shelling is needed.

Table 4 shows the total aflatoxin concentration of the OVERS and its components. The aflatoxin concentration was reduced in 12 of the 17 trailers by belt screening alone, and the reduction ranged from 7 to 94%. None of the four trailers with aflatoxin above the 20 ppb acceptable level was reduced to below 20 ppb by belt screening alone. However, the average aflatoxin reduction in those four trailers was 27% by belt screening. In one trailer the aflatoxin concentration was unchanged, and belt screening resulted in an increased aflatoxin concentration in the OVERS in four trailers as compared to the total unscreened load. An examination of the LSK components for the four trailers in which the total OVERS aflatoxin concentration was higher than in the total load (trailers 2, 3, 11, 17) reveals that these LSK aflatoxin concentrations were very low and did not contribute greatly to the total load aflatoxin. This points out the fact when overall aflatoxin concentrations are low (as they were in trailers 2, 3, 11, 15, and 17) and are very low in the LSK, belt screening would not play a significant role in aflatoxin reduction. However, when LSK aflatoxin concentrations are high, as is usually the case in loads with significant contamination, belt screening is more effective because of the efficient LSK removal (97% of the LSK removed by the belt screen).

Table 1. Mean aflatoxin concentrations in components of unscreened farmers stock peanuts (ppb)[a].

Trailer	Total	SMK+SS	OE	OS	DK	LSK
1	14.0	0.2	15.6	32.9	69.6	114.1
2	8.7	0.0	71.2	52.6	79.3	2.9
3	1.4	0.1	4.7	1.7	19.7	0.2
4	1.3	0.2	0.0	8.4	3.0	17.5
5	9.7	0.0	13.9	0.2	636.1	99.5
6	1574.7	45.2	828.6	882.7	29729.4	5286.3
7	148.1	6.9	67.4	144.0	4117.1	439.5
8	3.0	0.0	0.1	5.3	42.6	8.9
9	57.0	1.0	27.2	15.3	2639.8	457.0
10	1.8	0.1	0.0	0.3	36.3	26.2
11	2.9	0.2	31.4	0.1	47.0	0.6
12	35.7	0.0	14.9	1.5	1833.1	50.5
13	3.9	0.1	0.0	0.9	7.1	74.8
14	5.7	0.4	0.0	0.1	45.3	103.8
15	0.1	0.0	0.0	0.3	0.7	0.0
16	14.2	0.1	3.3	2.0	92.7	203.3
17	0.5	0.0	0.0	20.6	3.5	0.0
Avg.	110.7	3.2	63.4	68.2	2317.7	406.6

[a]Values are the mean of 10 determinations.

Table 2. Percent of components by weight in the total load, OVERS, and THRUS.

	SMK+SS	OE	OS	DK	LSK	Sum
Total Load	76	8	6	1.5	8.5	100
OVERS	85	8	5	1.7	0.3	100
THRUS	21	10	12	0.4	56	99.4

Table 3. Percent of components riding over and falling through the belt screen.

	Total	SMK+SS	OE	OS	DK	LSK
OVERS	85	96	82	69	96	3
THRUS	15	4	18	31	4	97

Overall, the average aflatoxin reduction per trailer by belt screening alone was 35%. However, the importance of removing DK, OS, and OE from the OVERS by further screening and sorting to achieve maximum aflatoxin reduction is illustrated by the fact that the average aflatoxin concentration of the OVERS was reduced from 90.5 ppb to 3.8 ppb by that removal. Removal of these 3 components results in a loss of only 15% of the total kernels in the OVERS. Since aflatoxin concentrations in SMK+SS is very low, and since very few SMK+SS are removed by belt screening, no effect of belt screening on SMK+SS aflatoxin levels was seen. The average aflatoxin reduction per trailer